

What is claimed is:

- 5 SUB C1
1. A method for producing a polycyclic aromatic hydrocarbon comprising:
 - a. condensing at least one carbon-containing material in a flame to form a condensed phase; and
 - b. collecting at least a portion of the condensed phase from the flame; wherein the condensed phase comprises at least one polycyclic aromatic hydrocarbon.
 - 10 2. The method of Claim 1, wherein the polycyclic aromatic hydrocarbon is a compound having more than 6 carbon atoms bonded to form at least two rings, and at least one carbon-hydrogen bond; and wherein at least one of the rings is an aromatic ring.
 - 15 3. The method of Claim 1, wherein the polycyclic aromatic hydrocarbon comprises a plurality of fused five and six membered rings.
 - 20 4. The method of Claim 1, wherein the polycyclic aromatic hydrocarbon comprises one or more of the polycyclic hydrocarbons identified by the National Institute of Standards and Technology Special Publication 922, or a partially hydrogenated derivative thereof.
 - 25 5. The method of Claim 1, wherein the polycyclic aromatic hydrocarbon has sufficient hydrogen atoms to have at least one ring with at least one saturated -CH₂- group.
 6. The method of Claim 1, wherein the polycyclic aromatic hydrocarbon comprises at least one low molecular weight polycyclic aromatic hydrocarbon, at least one high molecular weight polycyclic aromatic hydrocarbon, or a mixture thereof.
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7. The method of Claim 6, wherein the low molecular weight polycyclic aromatic hydrocarbon has from about ten to about thirty carbon atoms.

8. The method of Claim 6, wherein the low molecular weight polycyclic aromatic hydrocarbon has a molecular weight from about 140 to about 400 grams per mole.

9. The method of Claim 6, wherein the high molecular weight polycyclic aromatic hydrocarbon has from about thirty carbon atoms to about 1000 carbon atoms.

10. The method of Claim 6, wherein the high molecular weight polycyclic aromatic hydrocarbon is an oil.

11. The method of Claim 1, wherein the condensed phase comprises a liquid phase.

12. The method of Claim 11, wherein the condensed phase further comprises a solid phase.

13. The method of Claim 1, wherein the condensed phase comprises a plurality of particles.

14. The method of Claim 13, wherein at least a portion of the particles have a smallest linear dimension of at least about 5×10^{-8} meters.

15. The method of Claim 1, wherein the condensed phase additionally comprises soot.

16. The method of Claim 1, wherein the collecting step comprises separating the condensed phase from the flame.

17. The method of Claim 1, wherein the collecting step further comprises isolating the condensed phase.

18. The method of Claim 1, wherein the collecting step comprises quenching the flame with a diluent gas, and separating the condensed phase from the diluent gas.

19. The method of Claim 1, wherein the collecting step comprises removing the condensed phase from the flame by suction.

20. The method of Claim 1, further comprising the step of extracting the collected condensed phase with an extraction medium.

21. The method of Claim 20, wherein the extraction medium comprises an organic solvent.

22. The method of Claim 1, wherein the carbon-containing material comprises
 a. natural gas, petroleum, wood, coal, charcoal, graphite, or other carbon-containing materials derived from plants or animals; or
 b. waste, or waste products derived from waste reclamation activities.

23. The method of Claim 1, wherein the carbon-containing material comprises a hydrocarbon.

24. The method of Claim 1, wherein the carbon-containing material comprises an alkane, an alkene, an alkyne, an aromatic compound, or a mixture thereof.

25. The method of Claim 1, wherein the carbon-containing material comprises methane, ethane, ethylene, propane, butane, pentane, cyclopentane, methylcyclopentane, hexane, cyclohexane, methyl-cyclohexane, dimethyl-cyclohexane, acetylene,

propylene, butene, butadiene, cyclopentadiene, dicyclopentadiene, benzene, toluene, xylene, ethylbenzene, styrene, naphthalene, biphenyl, anthracene, phenanthrene, indene, or a mixture thereof.

- 5 26. The method of Claim 1, wherein the flame employs an oxidant.
27. The method of Claim 26, wherein the oxidant is air or O₂.
28. The method of Claim 1, further comprising:
- 10 (c) reacting the collected condensed phase to form at least one carbonaceous material.
29. The method of Claim 28 wherein the carbonaceous material comprises a fullerene, a nanotube, or a mixture thereof.
- 15 30. The method of Claim 29, wherein the fullerene is a C₆₀ compound having a carbon skeleton in the form of a closed truncated polyhedron of sixty vertices, or a C₇₀ compound having a closed carbon skeleton of seventy vertices.
- 20 31. The method of Claim 29, wherein the nanotube comprises a hollow tubule.
32. The method of Claim 31, wherein the hollow tubule has from about 1 to about 50 concentric cylindrical sheets of hexagonally-arranged carbon atoms.
- 25 33. The method of Claim 29, wherein the fullerene is a polycyclic compound having a non-planar carbon skeleton comprising fused five and/or six membered aromatic rings, having the formula C_{20+2m}H_n, where m is 0 or a positive integer, and n is less than m.

34. The method of Claim 28, wherein the reacting occurs in a liquid phase.
35. The method of Claim 28, wherein the reacting comprises heating.
- 5 36. The method of Claim 35, wherein the heating occurs at a temperature from about 150°C to about 2500°C.
37. The method of Claim 28, wherein the reacting comprises photolysis, dehydrogenating, polymerizing, reducing, or oxidizing.
- 10 38. The method of Claim 28, wherein the reacting produces H₂.
39. The method of Claim 28, wherein the reacting occurs in the presence of at least one agent.
- 15 40. The method of Claim 39, wherein the agent is a C₁-C₂₅ hydrocarbon, a polycyclic aromatic hydrocarbon, an oxidizing agent, a reducing agent, a free-radical inducing agent, a catalyst, or a mixture thereof.
- 20 41. The method of Claim 39, wherein the agent is a catalyst.
42. The method of Claim 41, wherein the catalyst is a metal or metal compound.
43. A method for producing fullerenes and nanotubes comprising:
- 25 a. heating at least one carbon-containing material to form a condensed phase comprising at least one polycyclic aromatic hydrocarbon;
- b. collecting at least some of the condensed phase;
- c. reacting the condensed phase to form fullerenes and/or nanotubes.

44. The product produced by the process of Claim 1.
45. The product produced by the process of Claim 43.

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